DISTRIBUTED KNOWLEDGE MANAGEMENT SYSTEM

Cross Reference to Related Application

The present application is related to co-pending, commonly assigned U.S. Patent Application Serial No. _____(Attorney Docket No. LEDS.00119) entitled ``Nomadic Digital Asset Retrieval System'' filed even date herewith. The content of the cross referenced co-pending application is hereby incorporated herein by reference for all purposes.

BACKGROUND OF THE INVENTION

1. Technical Field:

The present invention relates generally to computer software and, more particularly, to management of knowledge in the form of digital assets in a distributed data processing system.

2. Description of Related Art:

One aspect of Knowledge Management consists of acquiring, storing and retrieving digital assets that consist of separate or linked digital objects including text, audio, video, photographs, graphics and other related objects. In any corporation or enterprise, each of the activities of acquisition, storage, retrieval and use is performed by a different set of people, who could

be in the same or different business units, and located at one or more geographically dispersed offices.

The processes performed in the course of these activities are defined by informal and/or formal workflows that could be embedded in a Digital Asset Management System.

Digital Assets form a significant component of an organization's knowledge base and so it is important to foster collaboration and to promote re-use of digital assets. At the same time, a key objective is to enable each of the individuals to retain their independence and creativity without being constrained by the technical environment. It would be counter-productive to institutionalize the aspects of creation and re-use of digital assets, by imposing administrative and technology constraints.

All corporations are generating and acquiring considerable amounts of multi-media assets - from audio clips, phone messages, electronically delivered faxes, videos, still photographs, marketing collateral with a combination of multi-media objects. One approach to organizing all these digital assets and making them available in a knowledge management setting is to consolidate all these assets in a large repository, in a centralized location. The next step would be to provide a smart search engine that would allow for searching through this immense catalog of objects to facilitate retrieval. Though this is possible, it is not practical. As has been experienced before, even though a centralized

system exists, pockets of local assets develop over time and the corporation ends up in the same place that it started from - rendering the centralized system less powerful and relevant than expected.

Therefore, it would be desirable to have a centralized oversight and control of distributed digital assets of an enterprise, while enabling speedy search and retrieval techniques for promoting asset life extensions and re-use.

Significantly, such a system is supported by human behavior, where one tends to utilize immediately available local assets/ resources before engaging in enterprise level searches for relevant assets / resources.

SUMMARY OF THE INVENTION

The present invention provides a system for managing digital assets in a distributed data processing system. In one embodiment, the system includes a network of data processing systems, a plurality of local knowledge management servers connected to the network wherein each of the plurality of local knowledge management servers is connected to and maintains a local digital asset repository directly or through a Digital Asset Management software package, a central knowledge management server, and a central registry of knowledge assets. Each of the plurality of local knowledge management servers sends location and identifying information concerning a digital asset to the central knowledge management server whenever a digital asset is saved to a local digital asset repository corresponding to an appropriate one of the plurality of knowledge management servers. The central knowledge management server stores the location and identifying information concerning the digital asset in the central registry of digital assets.

BRIEF DESCRIPTION OF THE DRAWINGS

The novel features believed characteristic of the invention are set forth in the appended claims. The invention itself, however, as well as a preferred mode of use, further objectives and advantages thereof, will best be understood by reference to the following detailed description of an illustrative embodiment when read in conjunction with the accompanying drawings, wherein:

Figure 1 depicts a pictorial representation of a distributed data processing system in which the present invention may be implemented;

Figure 2 depicts a block diagram of a data processing system which may be implemented as a server in accordance with the present invention;

Figure 3 depicts a block diagram illustrating software architecture of a cKM application that may be implemented on a cKM server in accordance with one embodiment of the present invention;

Figure 4 depicts a block diagram illustrating an exemplary lKM application architecture that may be implemented on a lKM server in accordance with one embodiment of the present invention;

Figure 5 depicts a block diagram illustrating an exemplary connection pattern for an lKM server in accordance with one embodiment of the present invention;

Figure 6 depicts a block diagram illustrating retrieval of digital assets in accordance with one embodiment of the present invention;

Figure 7 depicts a process flow and program function diagram illustrating registration and storage of a digital asset in accordance with one embodiment of the present invention; and

Figure 8 depicts a process flow and program function diagram illustrating the retrieval of a digital asset in accordance with one embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

With reference now to the figures, and in particular with reference to **Figure 1**, a pictorial representation of a distributed data processing system is depicted in which the present invention may be implemented.

Distributed data processing system **100** is a network of computers in which the present invention may be implemented. Distributed data processing system **100** contains network **102**, which is the medium used to provide communications links between various devices and computers connected within distributed data processing system **100**. Network **102** may include permanent connections, such as wire or fiber optic cables, or temporary connections made through telephone connections.

In the depicted example, central Knowledge Management (cKM) server **104** is connected to network **102**, along with local Knowledge Management (lKM) servers **106-112**. In addition, a centralized "Golden" Registry **114** is connected to cKM server **104**. The "golden" registry **114** is a centralized registry of digital assets that exist across the organization from which all assets must be checked-in and checked-out for use. Digital assets may consist of separate or linked digital objects including text, audio, video, photographs, graphics, and other related objects.

lKM software runs on lKM servers **106-112** in the different locations of the enterprise offices where digital assets are created, acquired, stored, or retrieved. This may also include third party servers on which digital assets are created or re-purposed for consumption by the enterprise. The role of the lKM servers **106-112** is to perform automatic check-in/check-out of the digital assets with the central "Golden" registry **114**, update registry **114**, perform local security checks, comply with global security checks, determine the location of the requested digital asset, retrieve requested digital assets, and update the local asset management software (if any). In addition to these tasks, the lKM servers **106-112** possess a user interface that is easy to use and allows the user to perform additional administrative tasks and set up local work flows as needed. The lKM servers **106-112** are also responsible for the redundant saving of additional copies of the digital assets across lKM peers to ensure enterprise continuity. The lKM server **106-112** operate in real-time mode, but the user has the ability to set up specific tasks, such as, for example, retrieval of multiple assets and automatic cataloging of newly arrived local assets, to be performed in a batch mode or off-line. The lKM interfaces with other local applications including package digital asset management systems like Artesia (if any has been implemented on that site) that perform specific tasks like asset management, archiving, backup and restore, digital asset acquisition, ingestion

and formatting, directory services, security services, rights management and such.

The cKM software is an application that runs on a central cKM server **104** and performs several functions including authenticating the lKM servers **106-112**; providing access to the "golden" registry **114**; enabling automated check-in/check-out; version control; shadow registry for redundant copies; tracking usage of digital assets; capturing statistics of and about the digital asset; generating reports based on asset (usage, type), business unit, geography, revenues and similar metrics; ensuring global security checking; and a separate publish/subscribe mechanism for push/pull of digital assets (or asset information) for global or group broadcast of the asset (or asset information).

The lKM servers **106-112** and the cKM server **104** use a common open interface architecture that allows for each of them to interface with common off-the-shelf digital asset management products as well as related products like content management, portals, powerful context based multi-media search engines, DBMSs, systems management tools, reporting tools, data warehouse/data marts, ERP, SCM, and CRM suites.

The cKM server **104** is set up as a dashboard and has drill-down capability to obtain the necessary detail.

In the depicted example, distributed data processing system **100** is the Internet, with network **102** representing a worldwide collection of networks and gateways that use the TCP/IP suite of protocols to communicate with one

another. At the heart of the Internet is a backbone of high-speed data communication lines between major nodes or host computers consisting of thousands of commercial, government, education, and other computer systems that route data and messages. Appropriate use of encryption and/or Virtual Private Networks (VPNs) may be utilized in order to provide the necessary level of security for data transmitted across the Internet. Of course, distributed data processing system **100** also may be implemented as a number of different types of networks such as, for example, an intranet or a local area network.

Figure 1 is intended as an example and not as an architectural limitation for the processes of the present invention.

Referring to **Figure 2**, a block diagram of a data processing system which may be implemented as a server, such as any of servers **104-112** in **Figure 1**, is depicted in accordance with the present invention. Data processing system **200** may be a symmetric multiprocessor (SMP) system including a plurality of processors **202** and **204** connected to system bus **206**. Alternatively, a single processor system may be employed. Also connected to system bus **206** is memory controller/cache **208**, which provides an interface to local memory **209**. I/O bus bridge **210** is connected to system bus **206** and provides an interface to I/O bus **212**. Memory controller/cache **208** and I/O bus bridge **210** may be integrated as depicted.

Peripheral component interconnect (PCI) bus bridge **214** connected to I/O bus **212** provides an interface to PCI

local bus **216**. A number of modems **218-220** may be connected to PCI bus **216**. Typical PCI bus implementations will support four PCI expansion slots or add-in connectors. Communications links to network computers **108-112** in **Figure 1** may be provided through modem **218** and network adapter **220** connected to PCI local bus **216** through add-in boards.

Additional PCI bus bridges **222** and **224** provide interfaces for additional PCI buses **226** and **228**, from which additional modems or network adapters may be supported. In this manner, server **200** allows connections to multiple network computers. A memory mapped graphics adapter **230** and hard disk **232** may also be connected to I/O bus **212** as depicted, either directly or indirectly. Depending on whether server **200** is implemented as cKM server **104** or any one of lKM servers **106-112**, appropriate cKM or lKM software is stored, for example, on hard disk **232** and loaded into local memory **209** for execution by processor **202** and/or processor **204**.

Those of ordinary skill in the art will appreciate that the hardware depicted in **Figure 2** may vary. For example, other peripheral devices, such as optical disk drives and the like, also may be used in addition to or in place of the hardware depicted. The depicted example is not meant to imply architectural limitations with respect to the present invention.

Data processing system **200** may be implemented as, for example, an AlphaServer GS1280 running a UNIX® operating system. AlphaServer GS1280 is a product of

Hewlett-Packard Company of Palo Alto, California. "AlphaServer" is a trademark of Hewlett-Packard Company. "UNIX" is a registered trademark of The Open Group in the United States and other countries

With reference now to **Figure 3**, a block diagram illustrating software architecture of a cKM application that may be implemented on cKM server **104** in **Figure 4** is depicted in accordance with one embodiment of the present invention.

The cKM software essentially consists of the lKM software plus (global security **314**, golden repository **316**, check-in/check-out capabilities **318**, versioning **320** and application management modules **322**). The cKM application **300** because it includes the lKM software also includes an integration layer **304**, a workflow layer **306**, and a communication layer **308**. The cKM application **300** also includes pluggable interface connection extensions **310** and **312** that can connect to portal software, ingestion software, content management software and a variety of database management systems. Golden Repository **316** includes a full fledged multi-media repository as well as a robust quick-search indexing mechanism. If a pre-existing multi-media repository exists (eg. Like Artesia) then the pluggable interface connection extension **310** or **312** for Artesia is used instead. In all cases, the "golden repository" **316** will always exist.

The cKM application **300** architecture depicted in **Figure 3** is intended merely as an example and not as an

architectural limitation of the present invention. Those of ordinary skill in the art will appreciate that the components depicted in **Figure 3** may vary.

With reference now to **Figure 4**, a block diagram illustrating an exemplary lKM application architecture that may be implemented on any of lKM servers **106-112** in **Figure 1** is depicted in accordance with one embodiment of the present invention.

lKM application **400** includes a user interface layer **402** that allows a user to request and receive digital assets from the distributed knowledge management system. User interface layer **402** also allows a user to perform additional administrative tasks and set up local work flows as needed. lKM application **400** also includes an integration layer **404**, a workflow layer **406**, and a communication layer **408**. lKM application **400** may also include pluggable interface connectors **410** and **412**. The integration layer **404** consists of a set of standard entry and exit points into and out of the application facilitating easy integration of additional functionality, varied software packages and the building of pluggable interface connection extensions.

The workflow layer **406** leverages the tools that may already be available in the environment and acts as a pass through. If no such tools exist, then the workflow layer **406** provides a simple mechanism to set up routing of digital assets in the lKM context.

The communication layer **408** enables communication between lKMs and also between an lKM and the cKM.

Interaction with the Operating system, drivers, output devices and such is handled by the systems management layer.

The lKM application **400** architecture depicted in **Figure 4** is intended merely as an example and not as an architectural limitation of the present invention. Those of ordinary skill in the art will appreciate that the components depicted in **Figure 4** may vary.

With reference now to **Figure 5**, a block diagram illustrating an exemplary connection pattern for an lKM server is depicted in accordance with one embodiment of the present invention. Local digital assets may be stored on local digital asset repository **504**. Local digital asset repository **504** is connected to an lKM server **502** either directly or through an existing digital asset management package **512** (as illustrated) which is in turn connected to other lKMs **506** as well as to the cKM **508**. Digital content stored on local digital asset repository **504** is registered with the "golden" registry, such as, for example, "golden" registry **114** in **Figure 1**, through cKM **508**.

Thus, users from other lKMs **506** may access the local content stored on repository **504** by querying the "golden" registry through cKM **508** to determine where the requested digital content is stored and then accessing it through lKM server **502**. If not all users within the enterprise may access all digital content, then prior to providing the requested digital content, the cKM **508** or the lKM **502**

verifies that the requesting user is authorized to receive the requested digital content.

Thus, digital assets may continue to be stored locally, but are registered with a central "golden" registry so that users in other parts of the enterprise may be made aware of and have access to digital assets created and/or stored in another part of the enterprise.

With reference now to **Figure 6**, a block diagram illustrating retrieval of digital assets is depicted in accordance with one embodiment of the present invention. Rather than have digital assets in a central repository which would soon become obsolete as users within the enterprise create and store digital assets on local media, the digital assets in the present invention are stored in a distributed manner. Thus, each lKM server has a local digital asset repository as described above with reference to **Figure 5**. Therefore, when a user desires to retrieve a digital asset, rather than retrieve the asset from a centralized location, the lKM server **602** queries the "golden" registry for the location of the digital asset and then requests and receives the digital asset from the lKM server **606** on whose local digital asset repository the digital asset is maintained. (It should be noted that as far as lKM server **602** is concerned, all three layers o the lkMs are exchanging information, with the communication layer using a standard protocol to convey the data that the security and business rules layers wish to send.) Therefore, failure of a digital asset repository does not paralyze

the entire enterprise since not all digital assets are stored in a central location.

With reference now to **Figure 7**, a process flow and program function diagram illustrating registration and storage of a digital asset is depicted in accordance with one embodiment of the present invention. To begin, a user creates or otherwise obtains a digital asset (step **702**). The lKM server then receives a command from the user to store the digital asset (step **704**). The lKM server then determines the security level of the asset and the nature of which users should have access (e.g., local group only, global group, anyone, only users who supply appropriate password, etc.) to the digital asset (step **706**). This may be done either by presenting the user with a set of questions to answer or by some rule based method based on the identity of the user, the group to which the user belongs, and other similar data. Once the security level of the asset and nature of which users should have access to the digital asset are determined, the digital asset is stored on a local digital asset repository, such as, for example, local digital asset repository **504** in **Figure 5** (step **708**). The lKM server then sends the identity, storage location, security information, and any other relevant information concerning the digital asset that is desired in the particular embodiment of the invention to the cKM, such as, for example, cKM **104** in **Figure 1**, to save on the central "golden" registry of digital assets, such as, for example, golden registry **114** (step **710**). The cKM then

saves the location and other relevant information concerning the digital asset in the central "golden" registry of digital assets (step **712**).

With reference now to **Figure 8**, a diagram illustrating program function and process flow for retrieving a digital asset is depicted in accordance with one embodiment of the present invention. The lKM user interface will allow the user to access digital assets through two means - one by a search for an asset or by displaying a list of available assets based on user chosen criteria. The asset list will display the asset characteristics including thumbnails (if any for graphical assets), size, location , internal chargeback costs (if any), in-house or third-party asset and so on. The user then makes the request for an asset or a set of assets. The lKM server, after receiving the request from a user, queries the central "golden" registry via the cKM for the current location(s) and security constraints of the requested digital asset (step **802**). The cKM locates the entry for the requested digital asset within the central "golden" registry and sends the information about the requested digital asset to the requesting lKM. Thus, the lKM receives the location(s) and corresponding security constraint information of the requested digital asset(s) from the cKM (step **804**).

Using the "closest peer" algorithm based on network parameters, user over-rides, size of asset, security limitations and nature of asset the lKM then sends a request for the digital asset to a second lKM on whose

local digital asset repository the requested digital asset is contained (step **806**). The requesting lKM then may receive a request from the second lKM to authenticate that the requesting user has authority to access the requested digital asset (step **808**). The requesting lKM then sends authenticating information, such as, for example, a password to the second lKM (step **810**). If the second lKM is satisfied that the request is authorized, then the second lKM retrieves the digital asset from its local digital asset repository and sends it to the requesting lKM. The requesting lKM then receives the requested digital asset from the second lKM (step **812**). Then the requesting lKM updates the cKM and the second lKM updates the cKM (step **814**). The cKM then matches these two updates and updates the golden repository with the new location and version information (step **816**). The requesting lKM presents the requested digital asset to the requesting user (step **818**).

In some embodiments, the requesting lKM may know in advance (e.g., it may be obtained from the cKM along with the location of the requested digital asset) what type of authenticating information is required by the second lKM in order for the requesting lKM to receive the requested digital asset, thus eliminating the need for step **808** by presenting the required certificates along with the original request.

The process flows and program functions illustrated in **Figures 7** and **8** are intended merely as examples and not as limitations of the present invention. Those

skilled in the art will recognize many modifications that may be made to these process flows and program functions without departing from the scope or spirit of the present invention.

The present invention provides numerous advantage over the prior art. For example, to the users of the system, it is transparent whether the digital asset is available locally or remotely. Unless the user interface is configured by the user to display location information, all the communication and asset transfer takes place behind the scenes. Furthermore, the lKM interface is the common interface across all geographies, multiple digital management systems, organization boundaries and such. So users need to learn to use only one interface even though the enterprise could possibly have varied sets of digital asset management systems in place.

It is also important to note that whether a company has a single digital asset management system, multiple digital asset management systems or no digital asset management system, it is most practical to create a central repository of meta data about the digital assets. This provides centralized control with decentralized operations, which is how all organizations are structured. If the enterprise or company has no local digital asset management system, the lKM provides the basic digital asset management functions. Furthermore, centralized acquisition , ingestion, and re-purposing of digital assets is not practical. (It is like having all

your employees in one location - okay when you are small, impossible when you are a global enterprise). Local acquisition, local ingestion and global re-purposing in accordance with the present invention is most practical.

It is important to note that while the present invention has been described in the context of a fully functioning data processing system, those of ordinary skill in the art will appreciate that the processes of the present invention are capable of being distributed in the form of a computer readable medium of instructions and a variety of forms and that the present invention applies equally regardless of the particular type of signal bearing media actually used to carry out the distribution. Examples of computer readable media include recordable-type media such a floppy disc, a hard disk drive, a RAM, and CD-ROMs and transmission-type media such as digital and analog communications links.

The description of the present invention has been presented for purposes of illustration and description, but is not intended to be exhaustive or limited to the invention in the form disclosed. Many modifications and variations will be apparent to those of ordinary skill in the art. This embodiment was chosen and described in order to best explain the principles of the invention, the practical application, and to enable others of ordinary skill in the art to understand the invention for various embodiments with various modifications as are suited to the particular use contemplated.